

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 05-278158
(43)Date of publication of application : 26.10.1993

(51)Int.Cl. B32B 15/01
B32B 5/14

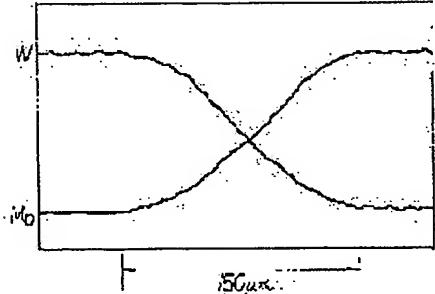
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(54) METAL-METAL INCLINATION FUNCTION MATERIAL

(57)Abstract:

PURPOSE: To provide a metal-metal bonded material withstanding high stress load by excluding a stress concn. source by constituting the bonded region to have a continuous composition change.

CONSTITUTION: In metals A, B mutually forming a perfect solid solution, a bonded material consists of a first metal layer composed of the metal A or a metal A base alloy and a second metal layer composed of the metal B or a metal B base alloy and the bonded part of the first and second metal layers is composed of a solid solution phase wherein the first and second metal components continue.



(19)日本国特許庁 (JP)

(12) 公開特許公報 (A)

(11)特許出願公開番号

特開平5-278158

(43)公開日 平成5年(1993)10月26日

(51)Int.Cl.⁵
B 32 B 15/01
5/14識別記号 K
府内整理番号 7016-4F

F I

技術表示箇所

審査請求 未請求 請求項の数 2(全 3 頁)

(21)出願番号

特願平4-76805

(22)出願日

平成4年(1992)3月31日

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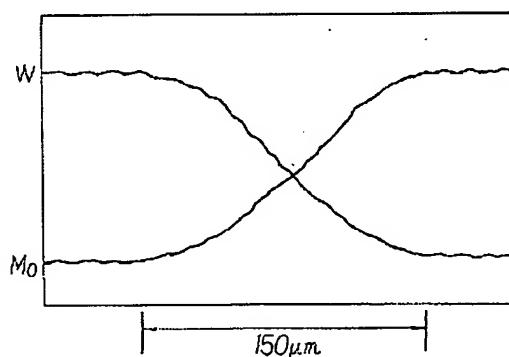
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(54)【発明の名称】 金属性傾斜機能材料

(57)【要約】

【目的】 接合領域を連続的な組成変化をすることによって、応力集中源を排して高応力負荷に耐える金属-金属接合材を提供する。

【構成】 相互に全率固溶する金属A、Bにおいて、金属Aまたは金属A基合金からなる第1金属層と、金属Bまたは金属B基合金からなる第2金属層とからなる接合材であって、前記第1金属層と前記第2金属層との接合部が第1金属成分と第2金属成分との連続した固溶率相からなる。



【特許請求の範囲】

【請求項1】少なくとも相互に全率固溶する金属A、Bにおいて、金属Aまたは金属A基合金からなる第1金属層と、金属Bまたは金属B基合金からなる第2金属層とからなる接合材であって、前記第1金属層と前記第2金属層との接合部が第1金属成分と第2金属成分との連続した固溶率相からなることを特徴とする、金属ー金属傾斜機能材料。

【請求項2】前記連続した固溶率相の厚さが15μm以上である、請求項1に記載の金属ー金属傾斜機能材料。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、高応力の負荷される接合材に関し、特に高い温度落差場のある所に使用される金属ー金属傾斜機能材料、たとえば、高温炉用の熱隔壁材や内壁面材として好適な金属ー金属接合材に関する。

【0002】

【従来の技術】従来、2種の金属材料を接合するにあたっては、ろう接、拡散接合などが行われている。しかし、このような接合では、接合部に組織の不連続な界面が生成し、この界面が応力負荷時に応力集中を起こし、破壊の起点となる。

【0003】たとえば、高温高強度材としては、超高温の必要な面にはW、蓄熱部にはより軽量なMoを用いたW-Mo接合材が用いられる。このW-Mo接合材はWおよびMoをMoペースト等でろう接、または拡散接合しているが、高強度な拡散接合材においても、その固溶領域は数μm～10数μm程度である。図2は、従来の拡散接合における、W-Mo接合材の接合界面領域のWとMoの組成の変化の様子を模式的に示すグラフであり、接合部界面領域（領域幅は約10μm）において、WおよびMoの組成が急激に変化している様子を示す。このため、高い応力負荷時には、この界面に応力が集中し、破壊の起点となる。

【0004】

【発明が解決しようとする課題】本発明は、上記の従来技術の問題点を解決して、接合領域を連続的な組成変化をすることによって、応力集中源を排して高応力負荷に耐える金属ー金属接合材を提供することを目的とする。

【0005】

【課題を解決するための手段】上記の課題を解決するために、本発明の金属ー金属傾斜機能材料は、少なくとも相互に全率固溶する金属A、Bにおいて、金属Aまたは金属A基合金からなる第1金属層と、金属Bまたは金属B基合金からなる第2金属層とからなる接合材であって、前記第1金属層と前記第2金属層との接合部が第1金属成分と第2金属成分との連続した固溶率相からなること、を特徴とするものである。

【0006】前記連続した固溶率相の厚さは15μm以

上であることが、好ましい。

【0007】前記第1金属層がWまたはW合金からなり、前記第2金属層がMoまたはMo合金からなるものが、好ましい。

【0008】発明の具体的説明

本発明の金属ー金属傾斜機能材料は、少なくとも相互に全率固溶する金属A、Bにおいて、金属Aまたは金属A基合金からなる第1金属層と、金属Bまたは金属B基合金からなる第2金属層とからなる接合材である。ここで、相互に全率固溶するというのは、金属Aと金属Bとが、すべての割合で固溶できることである。このような金属の組合わせとしては何ら特定されるものではないが、W-Mo、などが挙げられる。また、金属A基合金としては、3～15重量%Re-W、FeドープWなど各種合金が挙げられる。金属B基合金としては、0.6～4重量%Ti-Mo、0.6～4重量%Ti-O、3～2重量%Zr-Moなどの各種合金が挙げられる。

【0009】本発明の金属ー金属傾斜機能材料は、上記のような第1金属層と第2金属層とからなる接合材であって、第1金属層と第2金属層との接合部が、第1金属成分と第2金属成分との連続した固溶率相からなるものである。ここで、第1金属層と第2金属層との接合部が、第1金属成分と第2金属成分との連続した固溶率相からなるというのは、第1金属層から第2金属層へと、その接合部の組成が、第1金属層の組成から第2金属層の組成へと連続的に変化しており、接合部が実質的に不連続な界面を形成していないことを意味する。

【0010】このような連続した固溶率相からなる領域は、15μm以上、好ましくは50μm以上、さらに好ましくは100μm以上1000μm程度までが好ましい。領域幅が狭すぎると、実質的に界面が存在することと同じであって、応力集中源を排する効果を発揮することができない。上限は特に限定されるわけではないが、傾斜組成の連続性の保証などの点から1000μm程度までが好ましい。

【0011】図1は、一例として、W-Mo接合材の接合部領域のWとMoの組成の変化の様子を模式的に示すグラフであり、接合部領域（領域幅は約150μm）において、WおよびMoの組成が緩やかに変化している様子を示す。

【0012】このように、第1金属層と第2金属層との接合領域を連続した組成とし界面不存在とすることにより、かつまた接合領域を広範囲とすることにより、負荷応力を分散させて、接合領域にかかる局所応力を排除することができる。また、接合領域を広範囲とすることにより、第1金属層と第2金属層の各金属に依存する材料特性上の接合部における変化率を小さくさせることができる。従って、高温度落差等による高応力の負荷に耐える金属ー金属接合材を得ることができる。

【0013】本発明においては2層のみに限らず、3層

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以上の組合せにおいても可能である。

【0014】製造法

第1金属層と第2金属層との接合部が連続した固溶率相からなる金属一金属傾斜機能材料の製造法の一例を示せば、第1金属層を構成する金属（または合金）の粉末と第2金属層を構成する金属（または合金）の粉末とを、予備成形することなく積層した後、加圧成形し、その積層体を焼結する。これにより、接合部に連続的に組成の変化する傾斜組成層を作成することができる。

【0015】

【実施例】

実施例1

10 wt % Re-W合金粉末（平均粒径 3 μm ）250 g、0.5 wt % Ti-0.8 wt % Zr-Mo合金粉末（平均粒径 4 μm ）1000 gとを予備成形することなく積層した後、加圧成形し（成形圧 5 ton/cm²）、Ar雰囲気下、2200°Cで6時間焼結した。これによつて、接合部に 100~200 μm の領域で全率固溶反応によってWとMoの組成が連続的に変化する傾斜組成層が得られた。

【0016】このようにして得られた接合材（Re-W合金層厚：約 2 mm, Ti-Zr-Mo合金層厚：約 1.0 mm, 直径：5.0 mm）を 1500°Cで 30 分間加熱した後、鍛造を行なったところ圧下率 70%（厚さ約

3.6 mm）の鍛造によっても、接合領域での破壊が発生しなかった。

【0017】また比較として、厚さ 2 mm の 10 wt % Re-W合金板および厚さ 10 mm の 0.3 wt % Ti-0.8 wt % Zr-Mo合金板を Mo ベーストを介し、水素雰囲気中、1580°C、2 時間、圧力 50 kg/cm² で加圧接合し、従来の拡散接合材料（接合界面領域幅約 10 μm ）を得た。この従来の拡散接合材料を上記と同様の条件で鍛造を行なったところ、圧下率 10%（厚さ約 1.1 mm）の鍛造で接合界面での破壊が発生した。

【0018】

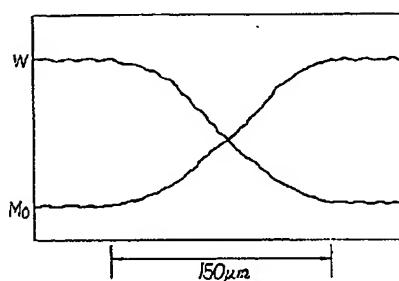
【発明の効果】本発明の金属一金属傾斜機能材料によれば、第1金属層と第2金属層との接合部が第1金属成分と第2金属成分との連続した固溶率相からなるものとしたので、応力集中源を排して高応力負荷に耐える金属一金属接合材を得ることができる。

【図面の簡単な説明】

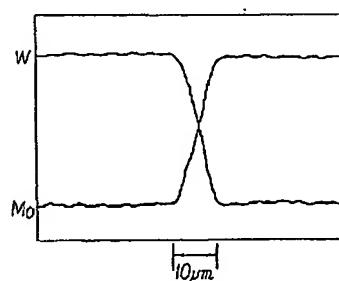
【図1】本発明における、接合材の接合部領域のWとMoの組成の変化の様子を模式的に示すグラフ。

【図2】従来の拡散接合における、W-Mo接合材の接合部領域のWとMoの組成の変化の様子を模式的に示すグラフ。

【図1】



【図2】



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CLAIMS

[Claim(s)]

[Claim 1]The 1st metal layer that becomes mutually from the metal A or a metal A group alloy in the metal A and B which carries out all the rate dissolution at least.

The 2nd metal layer that consists of the metal B or a metal B group alloy.

It is the metal-metal functionally gradient material provided with the above, and a joined part of said 1st metal layer and said 2nd metal layer consists of continuous dissolution **** of the 1st metallic component and the 2nd metallic component.

[Claim 2]The metal-metal functionally gradient material according to claim 1 whose thickness of said continuous dissolution **** is not less than 15 micrometers.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to metal-metal junction material suitable as the metal-metal functionally gradient material used for the place which has a high temperature fall place especially, for example, the heat partition material and internal-surface material for high temperature furnaces, about the jointing material of high stress by which load is carried out.

[0002]

[Description of the Prior Art] In joining two sorts of metallic materials conventionally, brazing and soldering, diffused junction, etc. are performed. However, in such junction, the discontinuous interface of an organization generates to a joined part, and this interface causes stress concentration at the time of stress load, and serves as a starting point of destruction.

[0003] For example, as an elevated-temperature high strength material, the W-Mo jointing material using lighter-weight Mo is used for the required field of a super-elevated temperature at W and a heat storage part. this W-Mo jointing material — W and Mo — Mo paste etc. — brazing and soldering — or although diffused junction is carried out, also in high intensity diffused junction material, that dissolution field is several micrometers — about about ten micrometers. Drawing 2 is a graph which shows typically the situation of change of a presentation of the joining interface field of a W-Mo jointing material of W and Mo in the conventional diffused junction.

In a joined part interface field (region width is about 10 micrometers), signs that the presentation of W and Mo is changing rapidly are shown.

For this reason, at the time of high stress load, stress concentrates on this interface and it becomes a starting point of destruction.

[0004]

[Problem(s) to be Solved by the Invention] An object of this invention is to provide the metal-metal junction material which eliminates the source of stress concentration and bears high stress load by solving the problem of the above-mentioned conventional technology and being made to carry out continuous presentation change for a junction area.

[0005]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, a metal-metal functionally gradient material of this invention, The 1st metal layer that becomes mutually from the metal A or a metal A group alloy in the metal A and B which carries out all the rate dissolution at least, It is a jointing material which consists of the 2nd metal layer that consists of the metal B or a metal B group alloy, and a joined part of said 1st metal layer and said 2nd metal layer consists of continuous dissolution **** of the 1st metallic component and the 2nd metallic component.

[0006] As for thickness of said continuous dissolution ****, it is preferred that it is not less than 15 micrometers.

[0007] What said 1st metal layer becomes from W or W alloy, and said 2nd metal layer becomes from Mo or Mo alloy is preferred.

[0008] A metal-metal functionally gradient material of concrete explanation this invention of an invention is a jointing material which consists of the 1st metal layer that consists of the metal A or a metal A group alloy mutually in the metal A and B which carries out all the rate dissolution at least, and the 2nd metal

layer that consists of the metal B or a metal B group alloy. Here, carrying out all the rate dissolution mutually is that the metal A and the metal B can dissolve at all the rate. W-Mo etc. are mentioned although not specified at all as combination of such metal. As a metal A group alloy, various alloys, such as Re-W and the Fe dope W, are mentioned three to 15% of the weight. As a metal B group alloy, various alloys, such as 0.6 to 4-% of the weight Ti-Mo and 0.6 to 4-% of the weight Ti-0.3 to 2-% of the weight Zr-Mo, are mentioned.

[0009]A metal-metal functionally gradient material of this invention is a jointing material which consists of the 1st above metal layer and the 2nd metal layer, and a joined part of the 1st metal layer and the 2nd metal layer consists of continuous dissolution **** of the 1st metallic component and the 2nd metallic component. That a joined part of the 1st metal layer and the 2nd metal layer consists of continuous dissolution **** of the 1st metallic component and the 2nd metallic component here To the 2nd metal layer, a presentation of the joined part is changing from a presentation of the 1st metal layer to a presentation of the 2nd metal layer continuously from the 1st metal layer, and it means that a joined part does not form a discontinuous interface substantially.

[0010]As for a field which consists of such continuous dissolution ****, even not less than 100 micrometers about 1000 micrometers are still more preferably preferred not less than 50 micrometers preferably not less than 15 micrometers. If region width is too narrow, an effect of it being as the same as an interface existing substantially, and eliminating a source of stress concentration cannot be demonstrated. Although especially a maximum is not necessarily limited, it is preferred. [of from points, such as a guarantee of the continuity of an inclination presentation, to about 1000 micrometers]

[0011]Drawing 1 is a graph which shows typically a situation of change of a presentation of a joined part field of a W-Mo jointing material of W and Mo as an example, and shows signs that a presentation of W and Mo is changing gently, in a joined part field (region width is about 150 micrometers).

[0012]thus, a thing which a junction area of the 1st metal layer and the 2nd metal layer is considered as a continuous presentation, and is considered as interface absence — and by making a junction area wide range again, load stress can be distributed and partial stress concerning a junction area can be eliminated. A rate of change in a joined part on a material property depending on each metal of the 1st metal layer and the 2nd metal layer can be made small by making a junction area wide range. Therefore, metal-metal junction material which bears load of high stress which a high temperature fall etc. depend can be obtained.

[0013]In this invention, it is possible also in combination of two-layer and three layers or more.

[0014]If an example of a manufacturing method of a metal-metal functionally gradient material which consists of dissolution **** which a joined part of the 1st metal layer of a manufacturing method and the 2nd metal layer followed is shown, After laminating powder of metal (or alloy) which constitutes the 1st metal layer, and powder of metal (or alloy) which constitutes the 2nd metal layer, without preforming, pressing is carried out and the layered product is sintered. An inclining composition layer from which a presentation changes to a joined part continuously by this can be created.

[0015]

[Example]

250 g of example 110wt%Re-W after alloy powder (mean particle diameter of 3 micrometers), 0. After laminating without preforming 1000 g of 5wt%Ti-0.8wt%Zr-Mo after alloy powder (mean particle diameter of 4 micrometers), pressing was carried out (moulding pressure 5 ton/cm²), and it sintered at 2200 ** under Ar atmosphere for 6 hours. The inclining composition layer from which the presentation of W and Mo changes with all the rate dissolution reactions to a joined part continuously in a 100-200-micrometer field was obtained by this.

[0016]Thus, after heating the obtained jointing material (about 2 mm, Ti-Zr-Mo alloy-layer thickness: Re-W alloy layer thickness : about 10 mm, a diameter : 50 mm) for 30 minutes at 1500 **, When forged, destruction in a junction area did not occur with the forge of 70% (about 3.6 mm in thickness) of rolling reduction, either.

[0017]As comparison, 2-mm-thick a 10wt%Re-W alloy plate and a 10-mm-thick 0.3wt%Ti-0.8wt%Zr-Mo alloy plate via Mo paste, Among a hydrogen atmosphere, application-of-pressure junction was carried out by pressure ² of 50kg/cm, and the conventional diffused junction material (joining interface region width of about 10 micrometers) was obtained for 1580 ** and 2 hours. When forged of the same conditions as the

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above, the destruction by a joining interface generated this conventional diffused junction material in the forge of 10% (about 11 mm in thickness) of rolling reduction.

[0018]

[Effect of the Invention] Since the joined part of the 1st metal layer and the 2nd metal layer shall consist of continuous dissolution **** of the 1st metallic component and the 2nd metallic component according to the metal-metal functionally gradient material of this invention, the metal-metal junction material which eliminates the source of stress concentration and bears high stress load can be obtained.

[Translation done.]

JP,05-278158,A [DESCRIPTION OF DRAWINGS]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The graph which shows typically the situation of change of a presentation of the joined part field of a jointing material of W and Mo in this invention.

[Drawing 2] The graph which shows typically the situation of change of a presentation of the joined part field of a W-Mo jointing material of W and Mo in the conventional diffused junction.

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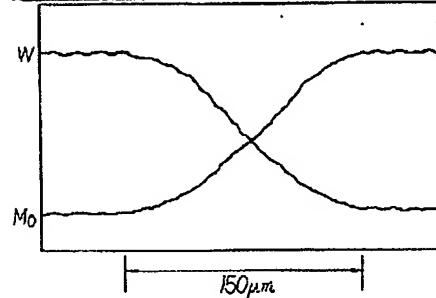
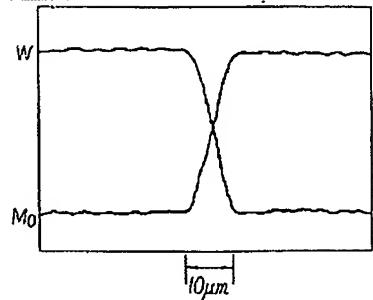
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DRAWINGS

[Drawing 1]**[Drawing 2]**

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